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Ultrafast carrier dynamics in CVD graphene probed by terahertz spectroscopy

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The relaxation of the electronic system in graphene plays a crucial role in a variety of proposed optoelectronic devices, including bolometers, photodetectors, and solar cells. Time-resolved terahertz spectroscopy affords the ability to probe the low-energy electrodynamics of carriers during relaxation. This is accomplished by exciting the electronic system with a strong 100 fs, 1.5 eV optical pulse and probing at variable time delay with a picosecond far-infrared pulse. Using this method to investigate carrier dynamics in CVD-grown graphene, we observe a positive change in the differential terahertz transmission after optical excitation. This new behavior contrasts with the negative change seen in previous measurements. Our experiments reveal a maximum change in transmission which decreases with increasing temperature. Additionally, the relaxation dynamics slow down with increasing excitation density, a trend which is not expected from typical electron-hole recombination dynamics. This qualitatively different response reveals new opportunities for manipulating optical response in graphene.

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